Austin Energy Regional Science Festival

IDEAS FOR SCIENCE FAIR PROJECTS TO DO AT HOME

Jr/Sr Research Project Ideas

This document includes ideas for projects that can be done at home from ISEF 2020 presentations as well as resources submitted by teachers and judges. The ISEF presentation links are included, so you can watch the presentations for more information.

ISEF Presentations

ISEF 2020 Presentation "Research At Home: Life Sciences Edition" by Dr. Bill Wallace and Dr. Tina Gibson

Process for Conducting Research at Home:

Ask good questions

Choose an appropriate model organism

Use simple and available technology

Obtain quantitative data and use statistical analysis

Use scientific thinking

To get students started thinking about ideas, have them read "Science News".

https://www.sciencenews.org/

Ideas for Model Organisms:

Animals:

- Pill bugs (learning and memory, classical association)
- Fruit flies (developmental biology, behavior)
- Planaria (cell proliferation)
- Bean Beetles (ecological resource sharing - bean to beetle ratio)
- Brine shrimp

Fungi:

- Yeast
- Edible mushrooms
- Slime molds

Plants:

- Scallion onions or Garlic (root tip experimentation)
- Red peppers
- Citrus (ascorbic acid)
- Legumes
- Wisconsin Fast plants
- Herbs
- Radishes

Examples of Experiments:

- Cell regeneration (plant hormones) using phototropism, chemotropism, gravitropism/geo, hydrotropism, thigmotropism, chromotropism
- Plant Physiology - research membrane transport system of plants, guard cell metabolism (observe guard cells by lifting imprint off leaves with tape and nail polish)
- Seed development - growing seeds for drought tolerance, turf grasses, various yard grasses, crops
- Choice chambers with petri dishes or bottles with PVC connector - allow flies to make choice using chambers, collect flies and then see if offspring have the same behaviors
- Can extract pigments and do chromatography experiments
- Can use Wisconsin Fast plants for genetic studies
- Cell phones can be used for photo microscopy (ex. planaria)
- Can photograph onion cells with cell phone through microscope
- Math modeling - Ex. pollution analysis, organ/tissue modeling, modeling of protein networks inside cells, GIS of hazard areas like where tornadoes are most likely or if impervious cover happens what would be flood risk, - use open source data
- WeatherSTEM app - soil moisture, water temperature
- Water analysis - relate to algal blooms, river ecology, erosion, plant life barriers, soil invertebrate biodiversity
- Environmental survey projects – put down a measuring tape 1 m long in a wooded area and identify every plant (and how many of each plant) within 10 cm of either side of the tape.

Repeat in a nearby area "claimed" by humans, and on the transition zone between the two areas (riparian). Do a species diversity analysis.

- Collect ball moss from trees and from the ground. Dunk each ball moss in a bucket of water and collect all the little invertebrates that come out of the ball moss. Identify all the invertebrates (and how many of each kind) for each ball moss. Compare ones on the ground to ones from the trees.
- Sit quietly in a park (maintain social distancing). Count how many people do certain activities. Change times of day and repeat.
- Sit quietly in a park (maintain social distancing). Count how many people come/go over the same time as how many birds come/go.

Schools can help students with resources for projects at home by starting a lending program for supplies - microscopes, balances, plasticware, petri dishes, safe chemicals, fruit fly vials, test tubes, etc.
Schools can establish partnerships with local businesses and universities to get access to supplies for students.

ISEF 2020 Presentation "Research At Home: Big Data and Engineering Edition" by David Black, Vince Joralemon, and Mike Carapezza

Challenge your students to use big data and interpret it using online resources in a way that is new.

Data Sources:

Earth Explorer - geological and geographical data - https://earthexplorer.usgs.gov/
NASA Geoscience Data - https://pds-geosciences.wustl.edu/
NASA Image Data - https://photojournal.jpl.nasa.gov/
NOAA Data - oceans, weather, climate - https://data.noaa.gov/datasetsearch/
CDC Disease Data - https://www.cdc.gov/DataStatistics/
US Census Bureau - demographics, population, voting - https://data.census.gov/cedsci/
Infrared Astronomy Data - https://irsa.ipac.caltech.edu/frontpage/

TinkerCAD:

This is a free online app for 3D design, electronics, and coding. https://www.tinkercad.com/

Mike Carapezzo shared links to worksheets he uses with his students to work with TinkerCAD, engineering design, and Arduino activities.
tinyurl.com/tinkercadworksheets
tinyurl.com/edpworksheets2020
tinyurl.com/arduinoworksheets

ISEF Research at Home Web Page

For more ideas from ISEF:

https://www.societyforscience.org/research-at-home/

Additional Resource Suggestions

Zotero – free citation manager plugin that integrates with Microsoft Word and Google - https://www.zotero.org/

Life Sciences

- Image J - Freeware that can be used to analyze images (coverage or band intensity)
- Plant Snap Phone App - https://www.plantsnap.com/ (plant identifier)
- Google Lens - https://lens.google.com/ (plant and animal identification)
- Cardiograph - heart rate app
- GenomicScape - http://www.genomicscape.com/ and Expression Atlas - https://www.ebi.ac.uk/gxa/home (These are just a few of the gene expression data sets and analysis tools that are available online. Students can research about a disease/condition of interest, learn how to use the analysis tools and then mine the available data sets to discover new information or test a theory they come up with during their research. There are DNA, RNA, miRNA and protein data sets available and more data is added all the time. These are most likely high school level projects.)
- Biological buffers pKa calculator - http://www.reachdevices.com/Protein/BiologicalBuffers.html
- Systems Biology Graphical Notation Information - https://sbgn.github.io/
- The virtual cell software – used for graphically and/or mathematically depicting cell physiology or intracellular signaling - https://vcell.org/run-vcell-software

- Compound (including commonly use fluorophores) spectral database - http://spectra.arizona.edu/
- Mouse Genome Informatics - http://www.informatics.jax.org/
- Rat Genome Database - https://rgd.mcw.edu/
- Genomic epidemiology of coronavirus - https://nextstrain.org/ncov/global
- Fully-curated transcription factor binding locations within the genomes of many model species - https://uswest.ensembl.org/index.html

Physical Sciences

- Science Journal Phone App - https://sciencejournal.withgoogle.com/ (sensors such as accelerometer, light, sound)
- PhyPhox - https://phyphox.org/ (sensors for physics experiments)
- Echo Earth International - www.earthecho.org (world wide water quality citizen scientist project, easy to use water quality kits)
- Citizen Science - www.citizenscience.gov/# (U.S. Government Website with numerous citizen scientist projects)
- ISTE - International Society for Technology in Education- www.iste.org (search citizen science, numerous resources including using smart phone for project)
- NASA - science.nasa.gov/citizenscience
- National Geographic - www.nationalgeographic.org/idea/citizen-science-projects/